Technical manual

MA. 4085
Audio Amplifier & AC Power Unit

MP MASTER
MA24123

RACAL Electronics Group

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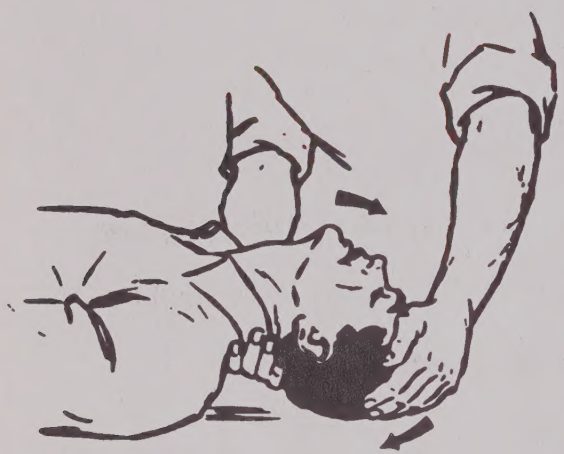
LETHAL WARNING

Voltages within this equipment are sufficiently high to endanger life.

Covers are NOT to be removed except by persons qualified and authorised to do so and these persons should always take extreme care once the covers have been removed.

Resuscitation instructions are given overleaf.

FIRST AID in case of Electric Shock



1. Lay victim on his back.
2. Clear victim's mouth and throat.
3. Tilt victim's head back as far as possible and raise his head.

4. Pinch victim's nostrils.
5. Take a deep breath.
6. Cover the victim's mouth with yours and blow, watching his chest rise.
   Note: Blow forcefully into adults, but gently into children.
7. Move your face away to allow victim to breathe out, watching his chest fall.
8. Repeat first five to ten breaths at a rapid rate; thereafter, take one breath every three to five seconds.
9. Keep victim's head back as far as possible all the time.

Have someone else send for a Doctor

Keep patient warm and loosen his clothing

DO NOT Give liquids until patient is conscious

HANDBOOK AMENDMENTS

Amendments to this handbook (if any), which are on coloured paper for ease of identification, will be found at the rear of the book. The action called for by the amendments should be carried out by hand as soon as possible.

NOTES

ALTERNATIVE TRANSISTOR TYPES

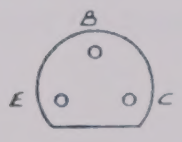
This addendum is applicable to the following equipments:-

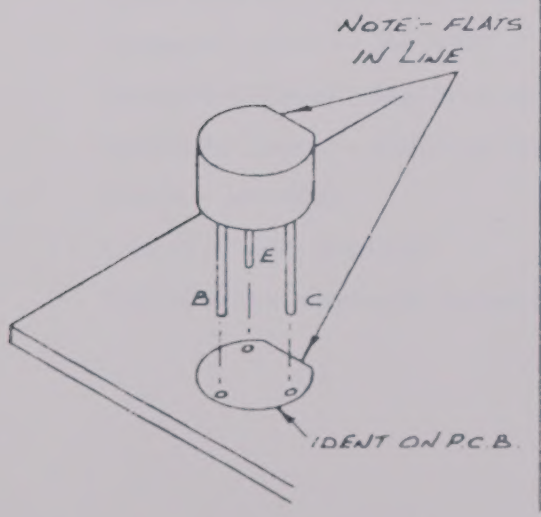
CA 531	MA 924L	MA 930P	MA 936	TA 970	MA 985B	MA 990
MA 907	MA 926	MA 930V	MA 937	TA 970H	MA 986B	MA 991
MA 923	MA 927	MA 930X	MA 937B	TRA 971	MA 987	MA 4001
MA 924	MA 930	MA 933	MA 949	MA 978	MA 988	
MA 924B	MA 930L	MA 935	MA 969	MA 984	MA 988B	

'E-line' (ZTX) Transistors may be used as a replacement for the original transistors listed below. Orientation of transistors on printed circuit boards (PCB's) should be carefully noted as illustrated below.

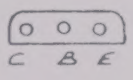
Original Transistor			Replacement Transistor	
Type	Racal Part No.		Type	Racal Part No.
BC 182 SX 3711	917465 915119	alternative	ZTX 237	923171
BC 212 SX 4060	919122 916092	alternative	ZTX 212	923172
2N 5450	915133	alternative	ZTX 3705	923170
*2N 5448	915118	alternative	ZTX 3703	923169

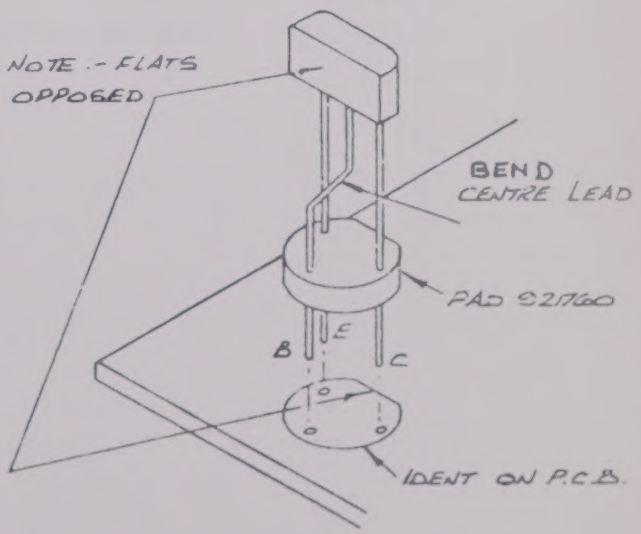
Configuration (as viewed from lead side of transistor).





Original Transistor Mounting Method





Replacement Transistor Mounting Method

* TR22 on the MA.924 Series and TR20 on the MA.930 Series, are 2N 5448. ZTX 3703 must not be used in these positions.

AUDIO AMPLIFIER AND A.C. POWER UNIT

TYPE MA.4085

INTRODUCTION

1. The Audio Amplifier and A.C. Power Unit type MA.4085 operates from an a.c. supply of either 100-125 volts or 200-250 volts. The power unit provides a regulated d.c. output of 24 volts for the TA.4044, 100 Watt Linear Amplifier.

2. The audio amplifier provides amplification for the Manpack audio output and delivers a maximum output of 1.0 Watt into a built-in loudspeaker.

CONSTRUCTION

3. The MA.4085 is enclosed in a metal case of overall dimensions 364 mm (14.3 in) x 200 mm (7.9 in) x 312 mm (12.3 in). The weight is 21.8 kg (48 lb). The series regulator transistors are mounted on a heat sink assembly at the rear of the unit.

4. The front panel carries all the controls and connectors as follows:

(a) SUPPLY ON/OFF switch

(b) SPEAKER ON/OFF switch

(c) A.C. supply input lead

(d) Two AUDIO sockets

(e) 24V output socket

(f) Power Indicator lamp

(g) Fuse

(h) Earth terminal

ELECTRICAL CHARACTERISTICS

5.

A.C. Mains Input:	100V to 125V or 200V to 250V, 47 to 60 Hz, 500 VA.
D.C. Output :	24V nominal at 17A maximum.
Audio Amplifier Sensitivity:	550 mV (1 mW into 300 ohms) maximum for 1.0W into 8 ohms at 1 kHz.
Audio Amplifier Output:	1.0W maximum into 8 ohms.

INSTALLATION

6. (1) Remove the ten screws securing the cover, and remove the cover from the unit.

(2) Ensure that the mains transformer toppings are correctly set for the local mains supply voltage by referring to Fig. 7.

(3) Ensure that the correct fuse is fitted (7A for 200V to 250V operation; 15A for 100V to 125V operation).

(4) Connect the MA.4085 to the Manpack and the TA.4044 Linear Amplifier as follows:-

(i) 6-way lead between an AUDIO socket on the TA.4044 and an AUDIO socket on the Manpack.

(ii) 6-way lead between the second AUDIO socket on the TA.4044 and an AUDIO socket on the MA.4085.

(iii) 4-way lead between the 24V socket on the MA.4085 and the DC SUPPLY plug on the TA.4044.

(5) Connect the EARTH terminal of the MA.4085 to a good earth unless the unit is to be earthed via the mains earth connection.

(6) Connect the mains supply as follows:-

Supply Cable		Mains Supply
Brown Wire	to	Line (L)
Blue Wire	to	Neutral (N)
Yellow/Green Wire	to	Earth (E)

OPERATION

7. Switch ON the supply and set the SPEAKER switch to ON or OFF as required.

CIRCUIT DESCRIPTION

24V Regulated Supply

Fig. 5

8. The 24 volt output at 2SK3 is compared with the reference voltage developed across zener diode 1D3. Any change in the voltage level at 1SK3 is detected by 1TR4 and the error signal at 1TR4 collector is applied, via 1D2, to 1TR1. The output of 1TR1 is current amplified by 2TR1 which drives series regulator 2TR2-2TR7.

9. 1TR3 is a current source for driving 1TR1 and is controlled by voltage detector 1TR4. Diode 1D2 prevents reverse polarity being applied across 1TR2 should 1TR4 be bottomed due to a sudden reduction from full load current to zero load current.

10. Overload protection is provided by 1TR2 which detects the increase in voltage across 2R27. The increased drive on 1TR2 decreases the drive on 1TR1 and 2TR1 and hence on series regulator 2TR2-2TR7. The setting of 1R3 determines the maximum power dissipated in the MA.4085.

11. Capacitors 1C1 and 1C4 provide r.f. decoupling, and 1C3/1R10 is a phase compensating feedback network which prevents oscillation occuring in the region of 100 kHz.

Audio Amplifier

Fig. 6

12, The audio signal at pin F of either 2 SK1 or 2SK2 is applied, via pin D5 of the Audio Amplifier board, to the two-stage voltage amplifier 4TR1, 4TR2. The output from 4TR2 feeds the driver stages 4TR5, 4TR6. Transistors 4TR5 and 4TR6 function as a complementary pair, to provide push-pull audio drive to the bases of the output transistors 4TR7 and 4TR8.

13. The audio output appearing between pins D2 and D1 is fed to the loudspeaker via switch SB. Negative feedback is applied from the output stage via 4R6 and 4R5 to 4TR1 emitter. Diodes 4D1 and 4D2 provide d.c. bias and thermal stability.

Overload Protection

14. Transistors 4TR3 and 4TR4 provide overload protection for the output transistors. For normal operating conditions, 4TR3 and 4TR4 are non-conducting. Should the amplifier be over-driven, the voltage developed across 4R13 and 4R12 will be sufficient to cause 4TR3 and 4TR4 to conduct. This will limit the base drive available to 4TR6 and 4TR5, and hence limit the maximum output current delivered by 4TR7 and 4TR8.

Muting

15. During transmission, closure of the PTT circuit applies an earth connection via pin D4 to the junction of 4R15 and 4R16. This action mutes the Audio Amplifier preventing acoustic feedback to the transmit audio path. Switch SB also breaks the h.t. feed in the speaker-off mode.

EQUIPMENT REQUIRED FOR TESTING

16. (a) Rheostat to cover the ranges 0-1.4 ohms at 17 amps.
(example: Berco DLSM, 168 ohms 15-0.18A).

(b) Multimeter to cover the range 0-100V d.c. and having a resistance of 20,000 ohms/V.

(example: AVO model 8).

(c) Moving coil d.c. ammeter 0-25A.

(d) Oscilloscope with a frequency range of 0-20 kHz and a sensitivity of 50 mV/cm.

(example: Advance OS2000).

(e) Variac, 0-260V at 5A.

(example: Zenith 100-RM).

(f) A.F. power meter with a bandwidth of 20 kHz an impedance of 8 ohms and an f.s.d. of 1.0W.

(example: Marconi TF893A).

(g) A.F. signal generator with a frequency range of 50 Hz - 20 kHz and an impedance of 600 ohms.

(example: Advance J2).

(h) A.F. valve voltmeter.

(example: Advance 77C).

(j) Manpack type TRA931X.

(k) Standard handset and Morse Key.

(l) 6-pin plug - Thorn Pygmy PT06W-10-6P.

(m) 4-pin plug - Plessey.

TEST PROCEDURE

24 Volt Supply

17. (1) Connect a rheostat (set to 1.4 ohms at 17 amps) in series with a 25 amp d.c. meter, between pins A and B of a 4-pin Plessey plug and connect it to the 4-pin 24V socket (2SK3) on the MA.4085.

(2) Connect a multimeter set to its 100V d.c. range, between pins A (positive) and B of the 4-pin plug.

(3) Connect the line input of an oscilloscope to pin A of the 4-pin plug and connect the ground terminal to pin B.

(4) Ensure that the transformer primary connections are correct for a mains supply of 240 volts.

(5) Connect the mains cable from the MA.4085 to a 5 amp Variac,set to 240 volts.

(6) Switch on the mains supply.

(7) Set the SUPPLY switch (SA) on the MA.4085 to ON and ensure that the indicator lamp is illuminated.

(8) Adjust the rheostat to give a load current of 17 amps and adjust 1R13 on the Regulator board to obtain a reading of 24.5 volts on the multimeter.

(9) Adjust the rheostat to give a load current of 20 amps and adjust 1R3 on the Regulator board until the output voltage just starts to fall.

(10) Vary the setting of the rheostat either side of the position set in para. 17 (8) and ensure that the load current does not exceed 20 amps.

(11) Adjust the rheostat to obtain a load current of 17 amps. Measure the a.c. ripple voltage displayed on the oscilloscope and ensure that it does not exceed 100 mV peak-to-peak.

(12) Reduce the output of the Variac until the a.c. ripple voltage is 150 mV peak-to-peak. Ensure that output voltage of the Variac is not greater than 216 volts.

(13) Connect a shorting link across the rheostat and ensure that the load current is within the limits 0.5 and 5 amps. Remove the shorting link.

(14) Remove the rheostat and increase the output of the Variac to 250 volts. Ensure that the voltage indicated on the multimeter is between 24.5 volts and 26.5 volts.

(15) Using the multimeter, set to its 100V d.c. range, ensure that there is no continuous d.c. potential between:-

pin A of 2SK3 and chassis
pin B of 2SK3 and chassis

(16) Set the SUPPLY switch (SA) to OFF and disconnect the test equipment from SK3.

(17) Reset the Variac to 240 volts output.

Audio Amplifier

18. (1) Unsolder the grey lead from the loudspeaker.

(2) Connect the line inputs of the oscilloscope and the A.F. power meter to the grey lead of the Amplifier board, and connect the ground terminals to the loudspeaker tag with the blue/brown lead.

(3) Connect the A.F. signal generator and the A.F. valve voltmeter between pins F (line) and D (earth) of a 6-pin Pygmy plug and connect it to one of the AUDIO sockets on the MA.4085.

(4) Set the frequency of the signal generator to 1 kHz and the output level to zero.

(5) Set the SUPPLY switch to ON and the SPEAKER switch to ON.

(6) Increase the output level from the signal generator until the power meter indicates 1.0 Watt. Ensure that the output waveform displayed on the oscilloscope is sinusoidal.

(7) Decrease the output level from the signal generator until the power meter indicates 0.5 Watt. Ensure that input level indicated on the valve voltmeter is not greater than 385 mV. Note the actual level.

(8) Set the frequency of the signal generator to 200 Hz maintaining the same input level as noted in para. 18 (7). Ensure that the output level indicated on the power meter is within the limits 100 mW and 300 mW.

(9) Set the frequency of the signal generator to 5 kHz maintaining the same input level as noted in para. 18 (7). Ensure that the output level indicated on the power meter is within the limits 400 mW and 600 mW.

(10) Set the SUPPLY switch to OFF and disconnect the test equipment from the AUDIO socket.

(11) Re-solder the grey lead to the loudspeaker.

Overall Check

19. (1) Connect the MA.4085 to the Manpack and the TA.4044 Linear Amplifier as follows:-

(i) 6-way lead between an AUDIO socket on the TA.4044 and an AUDIO socket on the Manpack.

(ii) 6-way lead between the second AUDIO socket on the TA.4044 and an AUDIO socket on the MA.4085.

(iii) 4-way lead between the 24V socket on the MA.4085 and the DC SUPPLY plug on the TA.4044.

(2) Connect a standard handset to the second AUDIO socket on the Manpack.

(3) Set the SUPPLY switch on the MA.4085 to ON and set the MODE switch on the Manpack to VOICE L.S.B.

(4) Ensure that the noise is heard from the loudspeaker (adjust the GAIN control on the Manpack as required).

(5) Operate the 'Pressel' switch on the handset and blow into the microphone. Ensure that sidetone is heard in the handset but that no output is heard from the loudspeaker.

(6) Transfer the 6-way AUDIO lead to the second AUDIO socket on the MA.4085.

(7) Repeat the procedure detailed in para. 19(4) and (5).

(8) Connect a morse key to the first AUDIO socket on the MA.4085.

(9) Select KEY L.S.B. on the Manpack.

(10) Operate the morse key and ensure that sidetone is heard in the loudspeaker.

(11) Set the SUPPLY switch to OFF and disconnect all test equipment from the MA.4085.

TYPICAL D.C. VOLTAGES

20. The following voltage levels were obtained under no load conditions and with a mains supply input of 240 volts. All measurements were taken with the multimeter negative lead connected to the negative terminal of capacitor 2C3/2C4.

REGULATOR

Multimeter +ve lead connected to	Emitter	Base	Collector
1TR1	25.3V	25.9V	44.0V
1TR2	24.6V	24.5V	25.9V
1TR3	43.5V	43.0V	26.0V
1TR4	6.2V	6.8V	26.0V
2TR1	25.5V	26.0V	44.0V
2TR2	25.0V	25.5V	44.0V
2TR3-7	24.5V	25.0V	44.0V

TYPICAL D.C. VOLTAGE (Cont'd)

AUDIO AMPLIFIER

D.C. INPUT TO BOARD	Note: Amplifier 24V d.c. supply is obtained from unit TA.4044		
Multimeter +ve lead connected to	Emitter	Base	Collector
4TR1	12.1V	11.5V	0.6V
4TR2	0V	0.6V	8.2V
4TR3	12.3V	12.3V	13.1V
4TR4	12.3V	12.3V	11.7V
4TR5	12.3V	11.7V	0V
4TR6	12.3V	13.1V	24.5V
4TR7	12.3V	12.5V	24.5V
4TR8	0V	0V	12.3V

ORDERS FOR SPARE PARTS

In order to expedite handling of spare part orders, please quote:-

(1) Type and serial number of equipment.

(2) Circuit reference, description and Racal part number.

(3) Quantity required.

NOTE: If the equipment is designed on a modular basis, please include the type and description of the module for which the replacement part is required.

LIST OF COMPONENTS

Cct. Ref.	Value Ω	Description	Rat.	Tol %	Racal Part Number
REGULATOR PCB					
Resistors					
1R1	1k	Fixed	1/3W	5	924680
1R2	4.7k	Fixed	1/3W	5	924689
1R3	4.7k	Preset Linear		10	920311
1R4	68k	Fixed	1/3W	5	924702
1R5	4.7k	Fixed	1/3W	5	924689
1R6	15	Fixed	1/3W	5	924622
1R7	1k	Fixed	1/3W	5	924680
1R8	33k	Fixed	1/3W	5	924699
1R9	470	Fixed	1/3W	5	924677
1R10	1k	Fixed	1/3W	5	924680
1R11	4.7k	Fixed	1/3W	5	924689
1R12	3.3k	Fixed	½W	5	906018
1R13	470	Preset Linear			920610
1R14	1k	Fixed	½W	5	906031
1R15	2.2k	Carbon Film	1/3W	5	924684
Capacitors					
1C1	0.1	Monolithic	100V	10	921368
1C2	0.001	Ceramic	40V	+100-20	924242
1C3	0.01	Fixed		+40-20	916187
1C4	0.1	Monolithic	100V	10	921368
1C5	.01	Ceramic	250V	-20+40	916187
1C6	.01	Ceramic	250V	-20+40	916187
1C7	4.7	Fixed	35V	20	914026
Diodes					
1D1		BAV10			918130
1D2		1N4149			914898
1D3		BZY88C6V2			911682

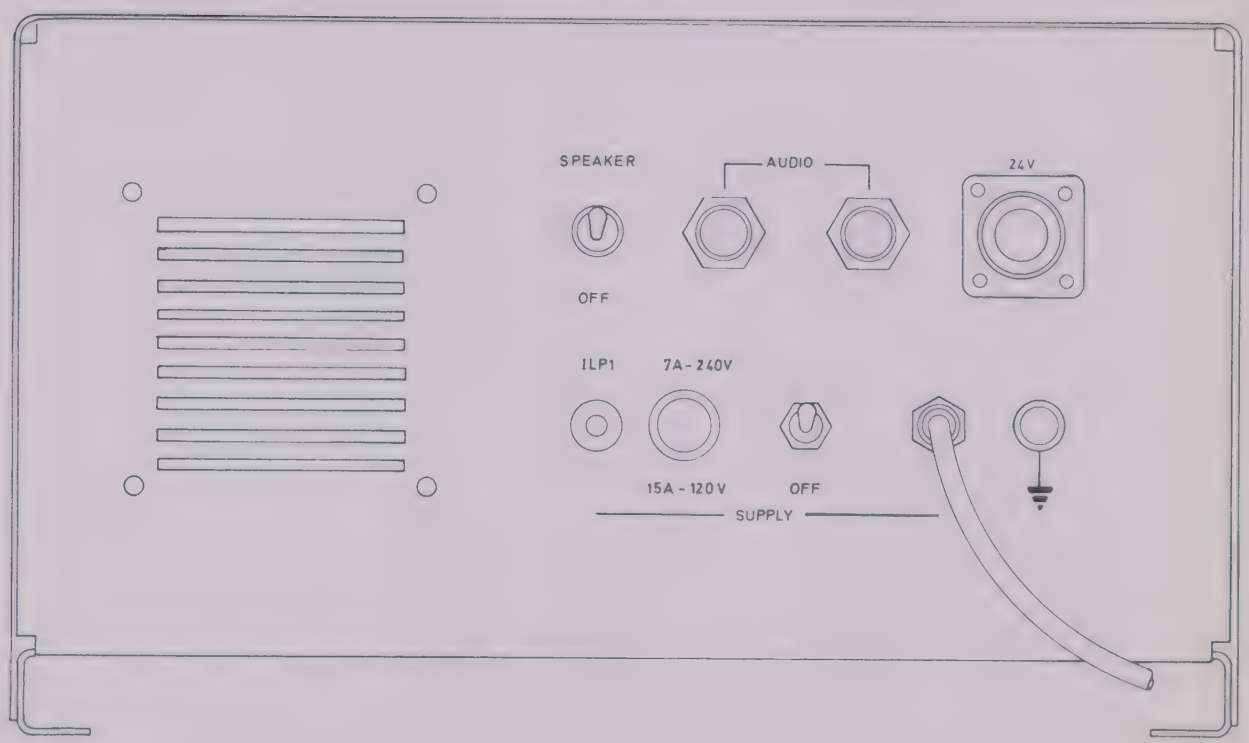
*Adjust on Test if required.
Value between 10Ω to 27Ω.

Cct. Ref.	Value Ω	Description	Rat.	Tol. %	Racal Part Number
Transistors					
1TR1		BUY80			926062
1TR2		ZTX304			921588
1TR3		ZTX504			928026
1TR4		ZTX304			921588
CHASSIS					
Resistors					
2R1	10	Fixed Wirewound	2.5W	5	913571
2R2	0.3	Fixed	9W	10	928484
2R3	0.3	Fixed	9W	10	928484
2R4	0.3	Fixed	9W	10	928484
2R5	0.3	Fixed	9W	10	928484
2R6	0.3	Fixed	9W	10	928484
2R7	10	Fixed Wirewound	2.5W	5	913571
2R8	4.7k	Fixed		5	906022
Capacitors (μF)					
2C1	0.01	Ceramic	250V	+40-20	916187
2C2	0.1	Monolithic	100V	10	921368
2C3	15,000	Electrolytic	63V	-10+50	917680
2C4	15,000	Electrolytic	63V	-10+50	917680
2C5	1000	Electrolytic	63V	-10+50	920877
2C6	1000	Electrolytic	25V	-10+50	919117
2C7	0.01	Disc Ceramic	250V	-20+40	916187
2C8	0.01	Ceramic	500V	10	918423
2C9-2C15	0.01	Ceramic	250V	+40-20	916187

Cct. Ref.	Value Ω	Description	Rat.	Tol. %	Racal Part Number
Diodes					
2D1		SUT 201A			928619
2D2		SUT201A			928619
2D3		SUT201A			928619
2D4		SUT201A			928619
Transistors					
2TR1		2N3055			906371
2TR2		2N3055			906371
2TR3		2N3772			911758
2TR4		2N3772			911758
2TR5		2N3772			911758
2TR6		2N3772			911758
2TR7		2N3772			911758
Transformers					
T1					DT710263
Fuses					
2FS1	7.0A (240V Operation)				924588
	15A (120V Operation)				917794
Switches					
SA		Toggle, 2-Pole			919251
SB		Toggle, 2-Pole			906883
Miscellaneous					
1LP1		Lampholder, green with resistor	a.c. 110V		928619
L.S.		Speaker, 8 ohm			917853
		Fuseholder			900005
AUDIO AMPLIFIER PCB					
Resistors					
4R1	56	Carbon film	¼	5	924666
4R2	5.6k	Carbon film	¼	5	924690
4R3	2.2k	Carbon film	¼	5	924684
4R4	6.8k	Carbon film	¼	5	924691
4R5	220	Carbon film	¼	5	924673

Cct. Ref.	Value Ω	Description	Rat.	Tol. %	Racal Part Number
Resistors (Contd.)					
4R6	1.5k	Carbon film	¼	5	924682
4R7	6.8k	Carbon film	¼	5	924691
4R8	68	Carbon film	¼	5	924667
4R9	1k	Carbon film	¼	5	924680
4R10	1k	Carbon film	¼	5	924680
4R11	1k	Carbon film	¼	5	924680
4R12	0.75	Wirewound	1½	10	916158
4R13	0.75	Wirewound	1½	10	916158
4R14	Not used				
4R15	1k	Carbon film	¼	5	924680
4R16	1k	Carbon film	¼	5	924680
4R17	1k	Carbon film	¼	5	924680
Capacitors (µF)					
4C1	0.01	Fixed	250V	+40-20	916187
4C2	4.7	Fixed	35V	20	914026
4C3	0.47	Fixed	35V	20	915168
4C4	0.01	Fixed	250V	+40-20	916187
4C5	4.7	Fixed	35V	20	914026
4C6	0.01	Fixed	63V	20	915173
4C7	4.7	Fixed	35V	20	914026
4C8	Not used				
4C9	680	Electrolytic	25V	-10+50	919118
Diodes					
4D1		IN4149			914898
4D2		IN4149			914898
4D3		IN4149			914898
Transistors					
4TR1		ZTX212			923172
4TR2		ZTX237			923171
4TR3		ZTX237			923171
4TR4		ZTX212			923172
4TR5		ZTX212			923172

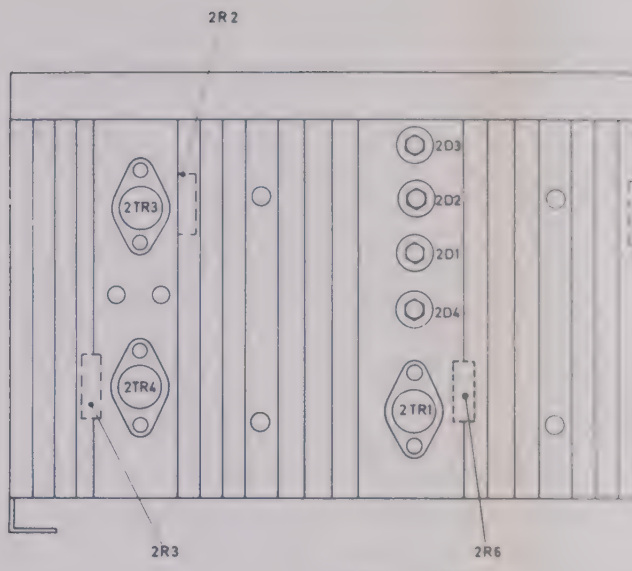
Cct. Ref.	Value Ω	Description	Rat.	Tol. %	Racal Part Number
Transistors (Contd).					
4TR6		ZTX237			923171
4TR7		2N3054			911951
4TR8		2N3054			911951



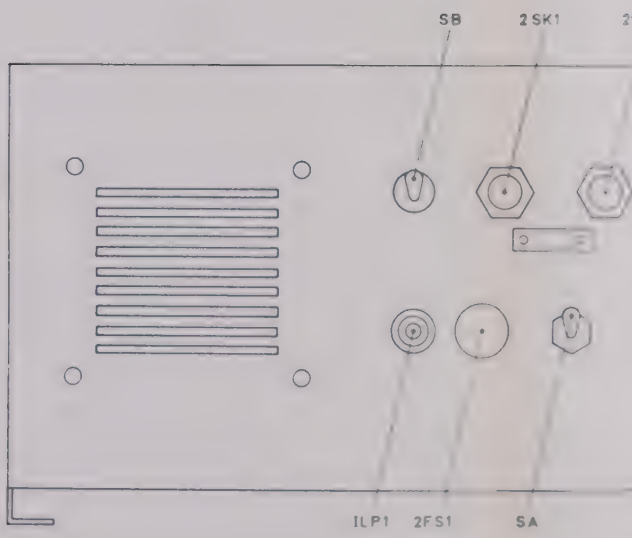
WOH 7130

Audio Amplifier
and A.C. Power Unit Type MA.4085

Fig. 1

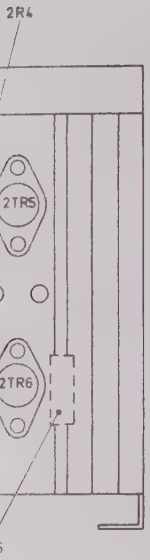


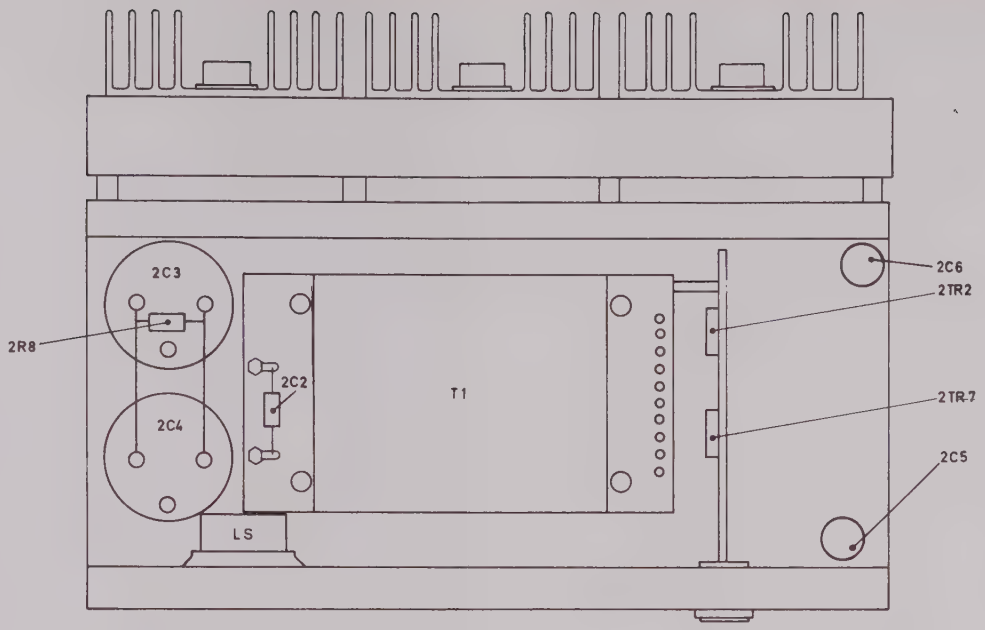
REAR VIEW



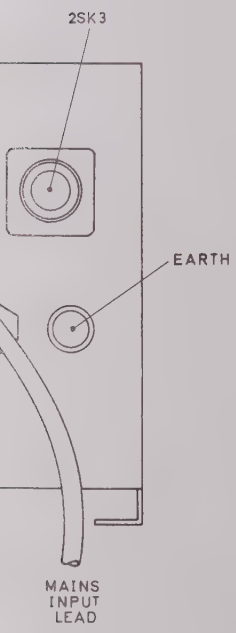
FRONT VIEW

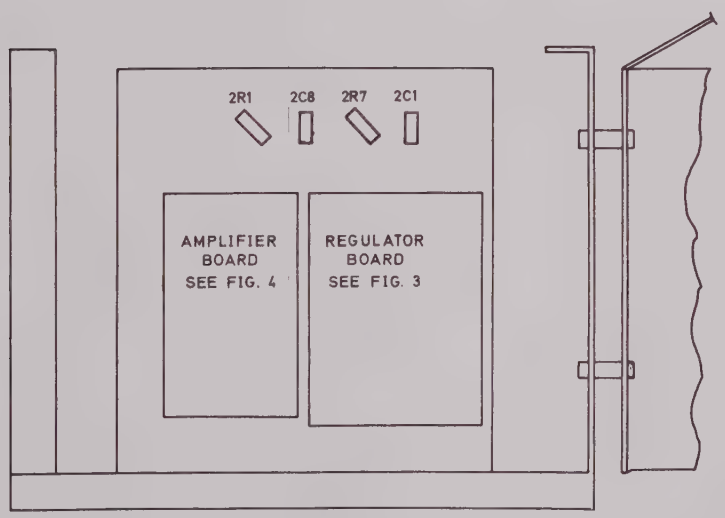
WOH 7130





TOP VIEW

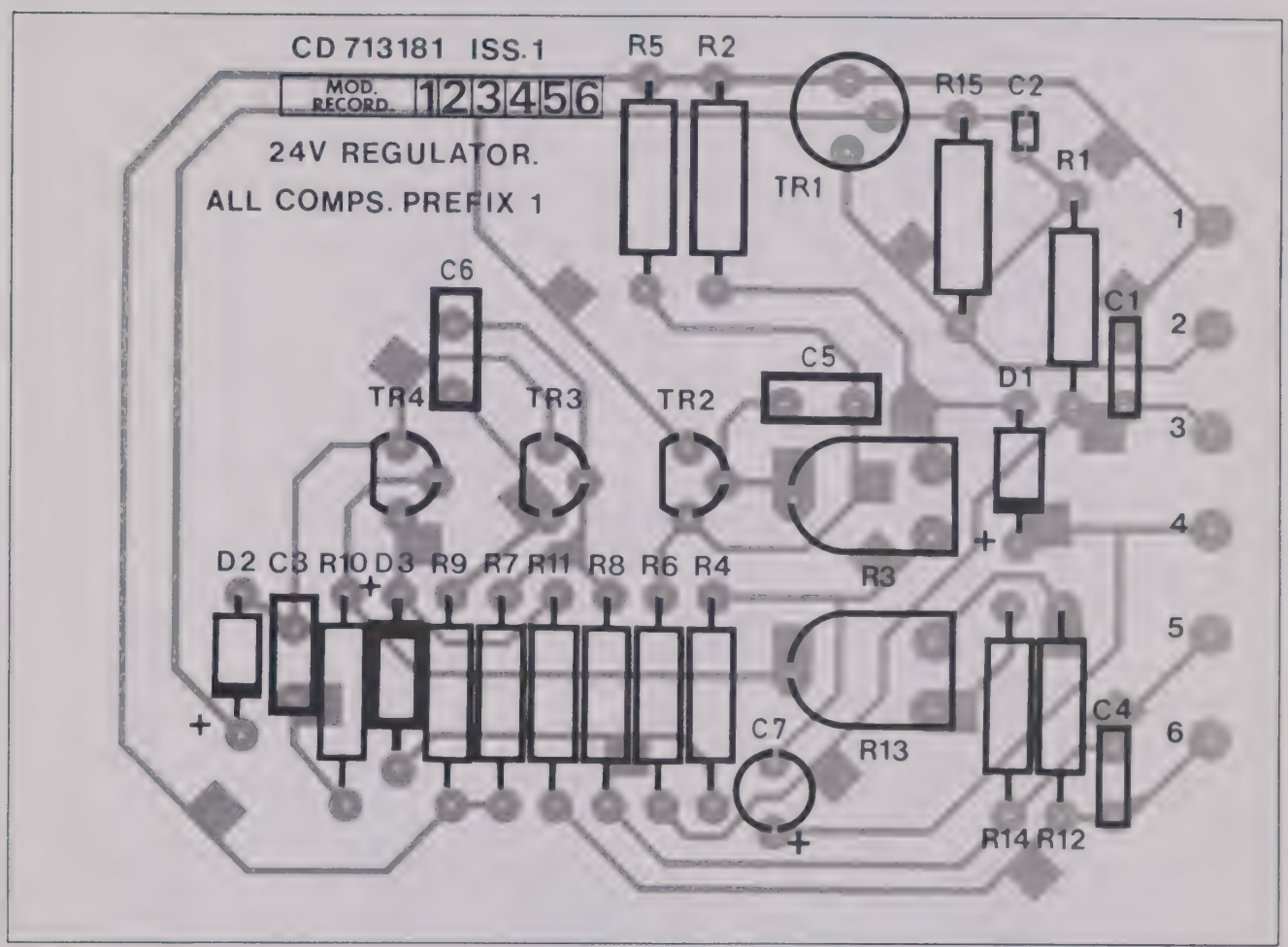




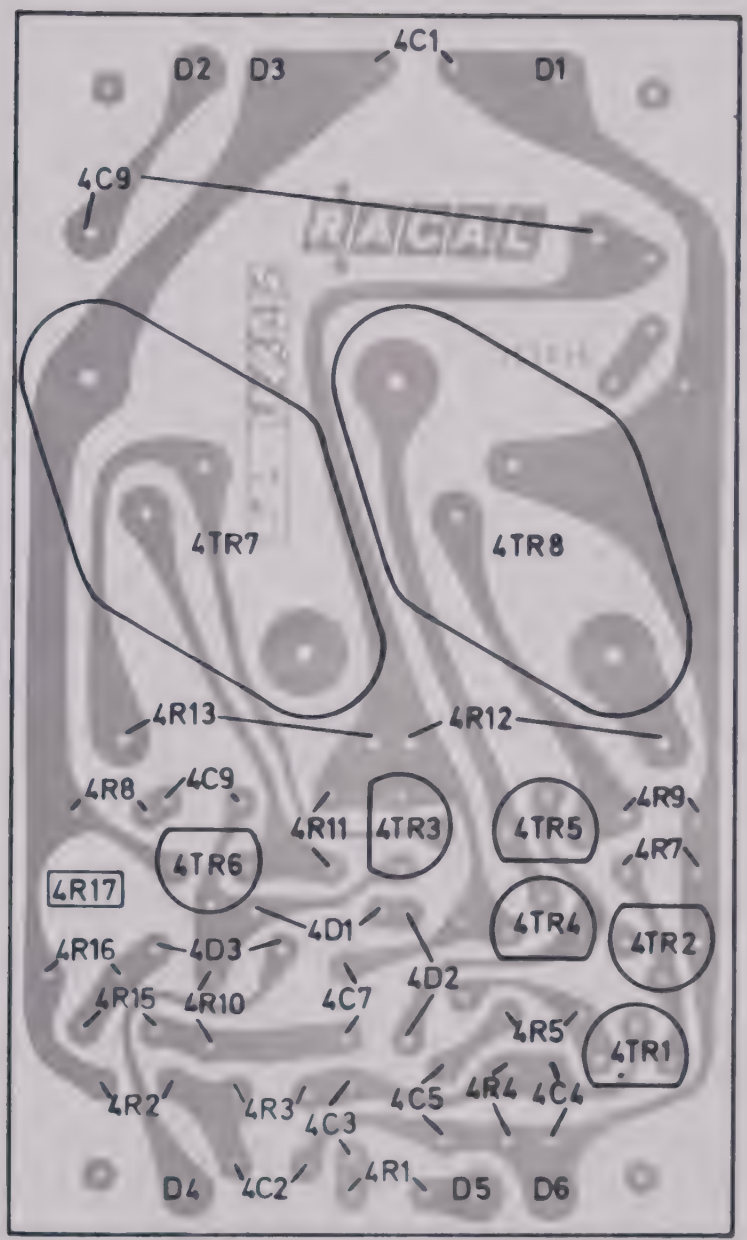
SIDE VIEW

Component Layout: MA. 4085

Fig. 2



Component Layout : Regulator Board Fig. 3

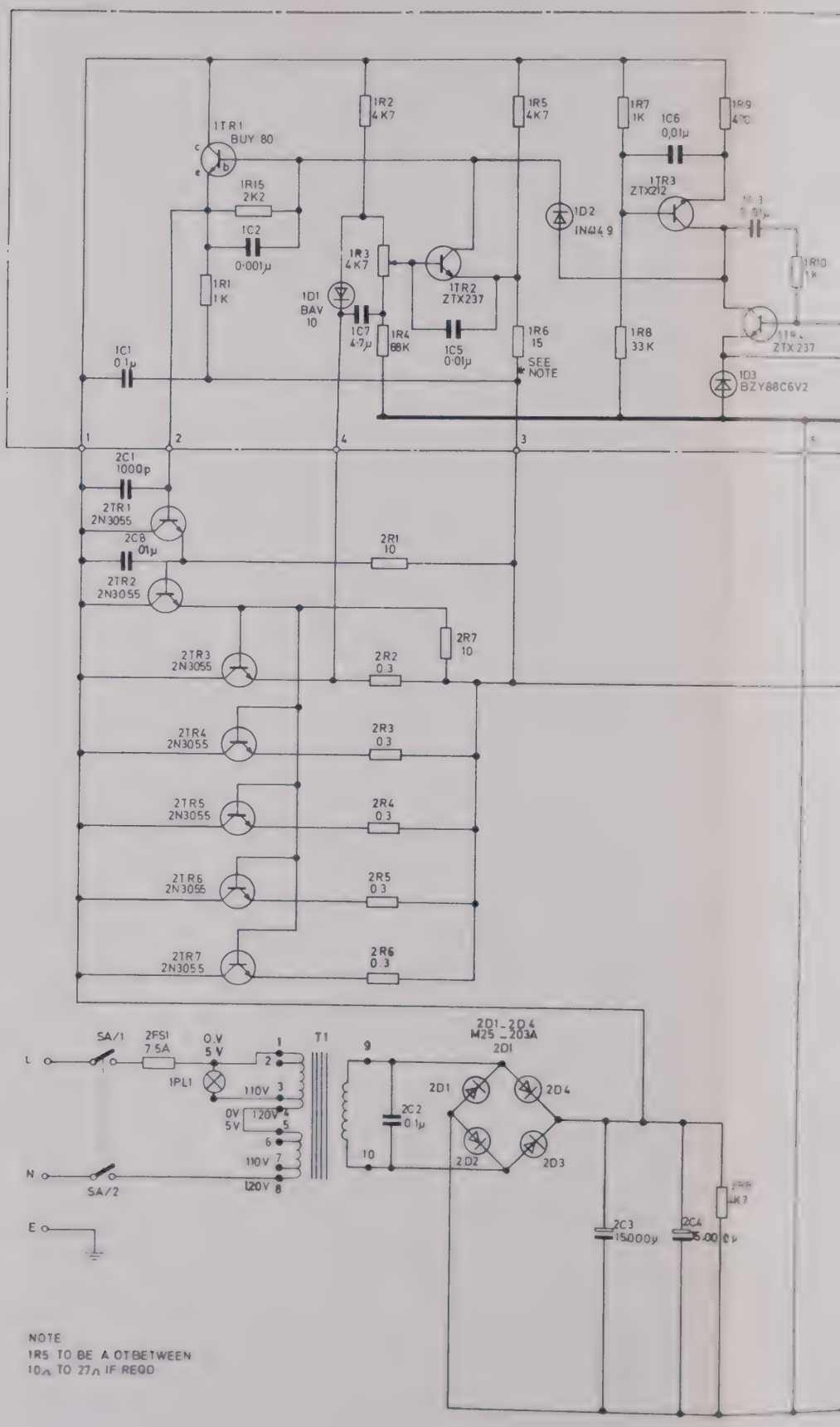


WOH7130	CD713034 SHT 2
1 2 4	

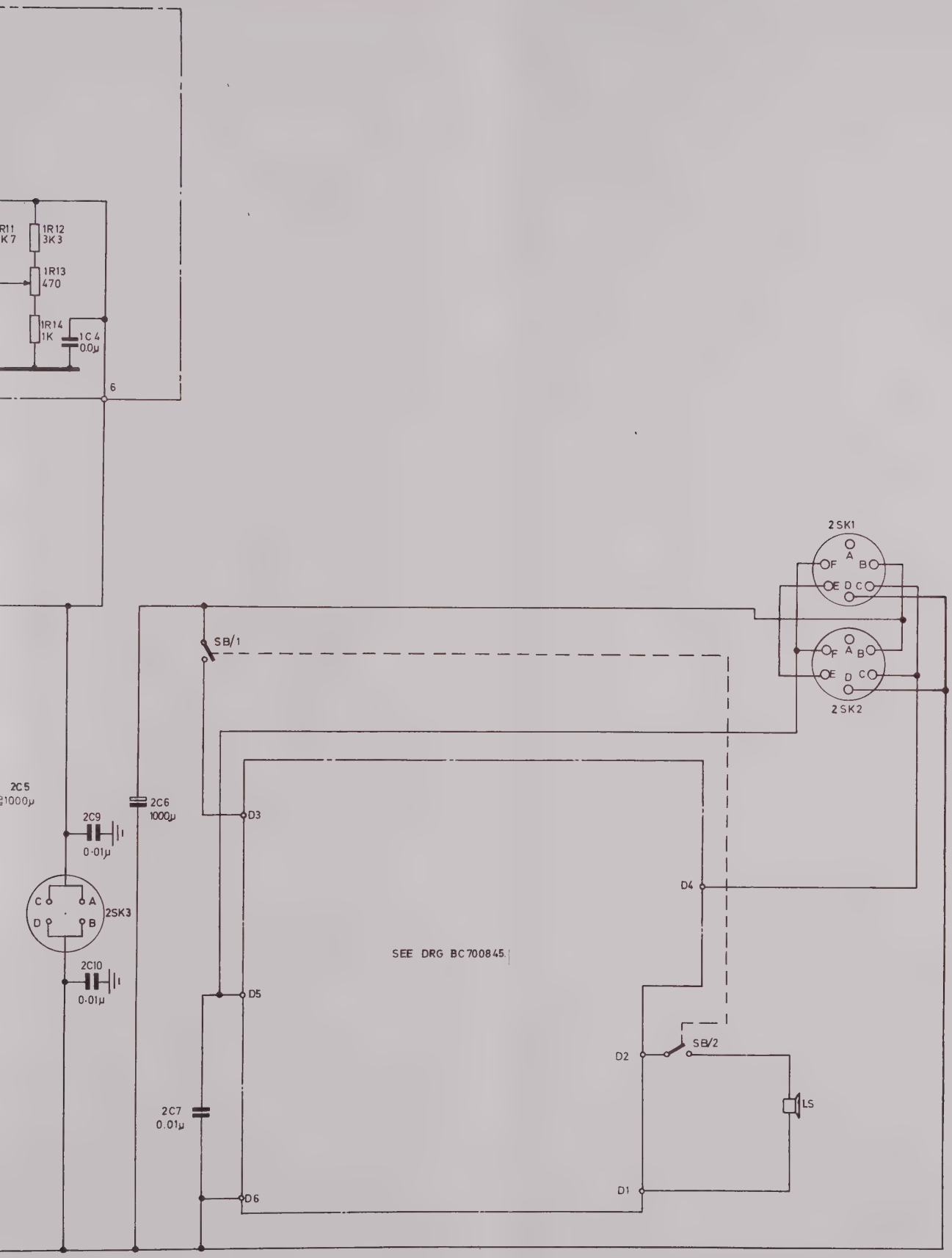
WOH 7130	CD713034 SHT. 3
1 4	

Component Layout:
Amplifier P.C.B

Fig.4

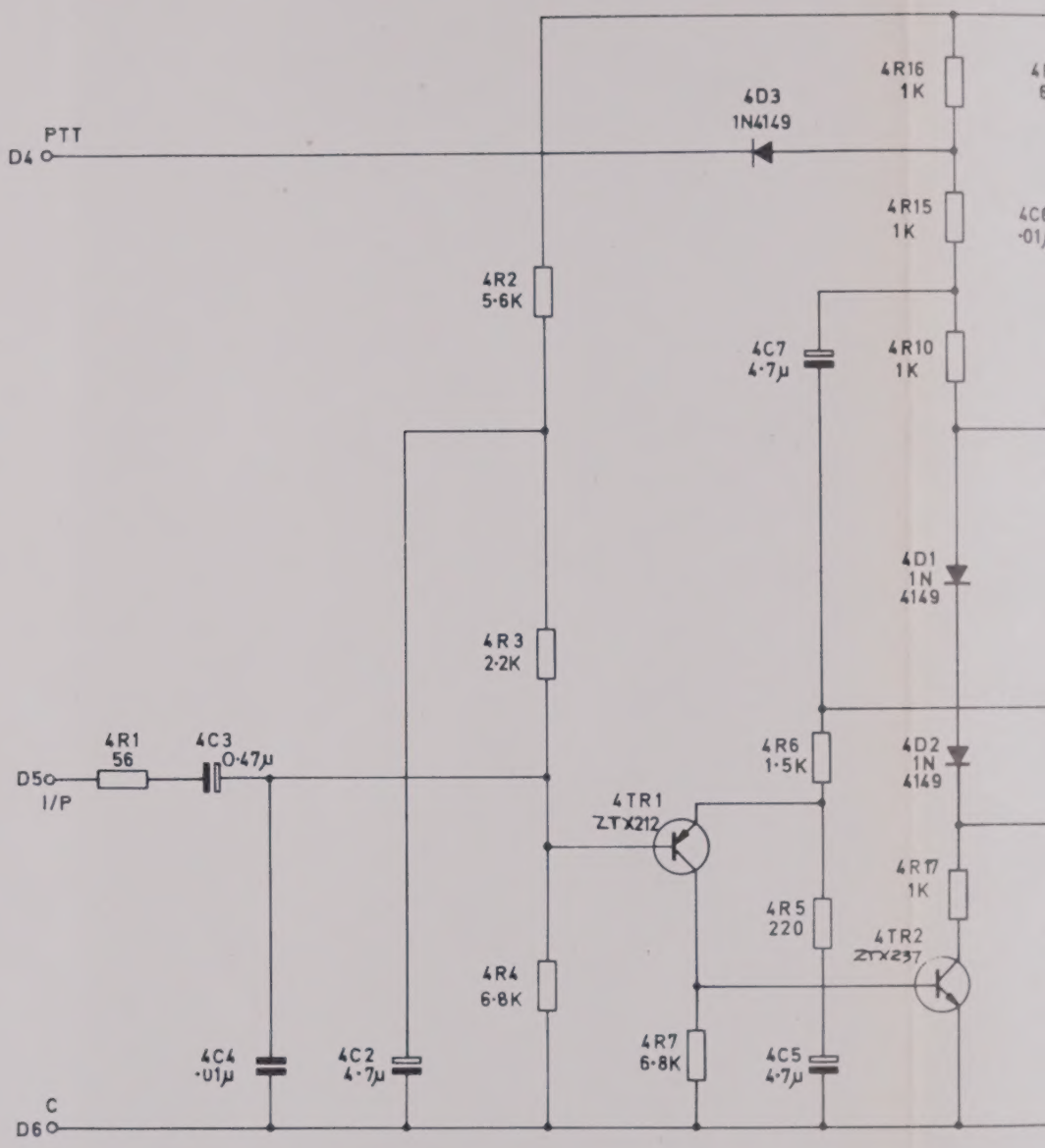


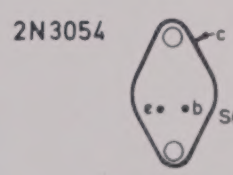
NOTE
1R5 TO BE A OTBETWEEN
10Ω TO 27Ω IF REQD



Circuit: MA.4085

Fig. 5

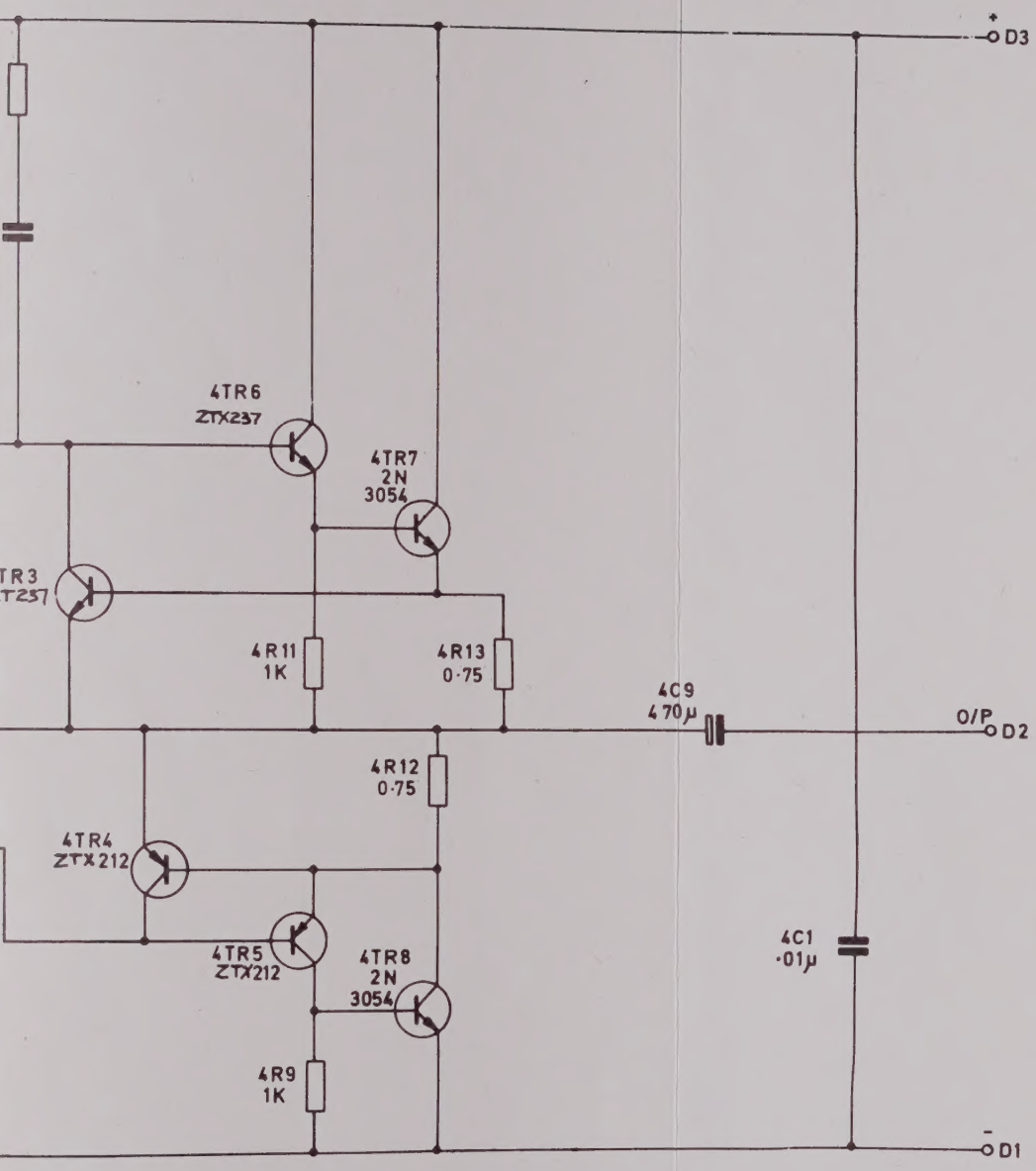




ZTX212
ZTX237

TRANSISTOR LEAD CONFIG
(AS VIEWED FROM LEA

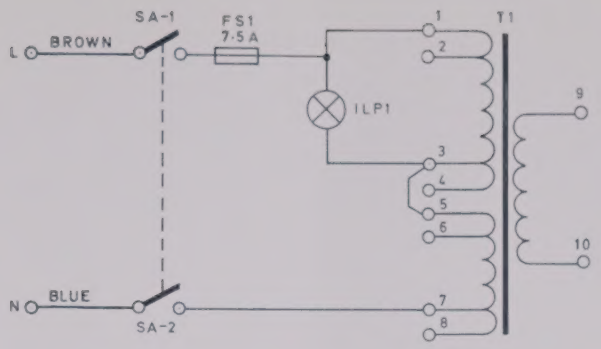
WOH 7130	CC 700845
5	10



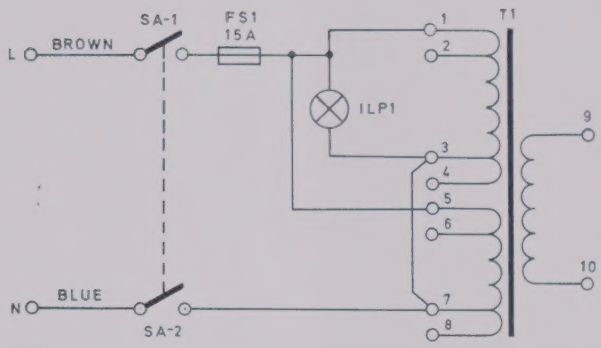
SCALE 4/1

ATION
IDE)

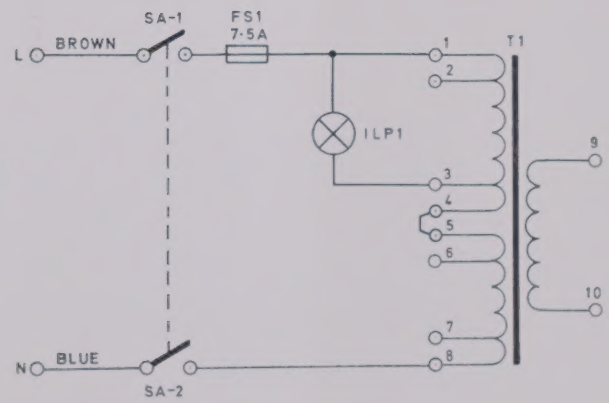
Circuit : Audio Amplifier Fig. 6



FOR 220V MAINS SUPPLY
DISCONNECT 4 AND RECONNECT TO 3
DISCONNECT NEUTRAL (BLUE) WIRE AT 8 RECONNECT TO 7



FOR 110V MAINS SUPPLY
DISCONNECT WIRE FROM 4 AND 6
DISCONNECT NEUTRAL (BLUE) WIRE 8 AND RECONNECT TO 7
CONNECT WIRE FROM 2 TO 6 AND 3 TO 7 AS SHOWN
REMOVE EXISTING FUSE (FS1) 7·5A AND INSERT 15A



FOR 240V MAINS SUPPLY
DISCONNECT LIVE (BROWN) WIRE 2 AND RECONNECT TO 1
DISCONNECT 7 AND RECONNECT TO 8

KEY TO DIAGRAMS								
TERMINAL No.	1	2	3	4	5	6	7	8
VOLTAGE	0V	+5V	110V	120V	0V	+5V	110V	120V

Typical Mains Transformer Connections

Fig.7

WOH 7130